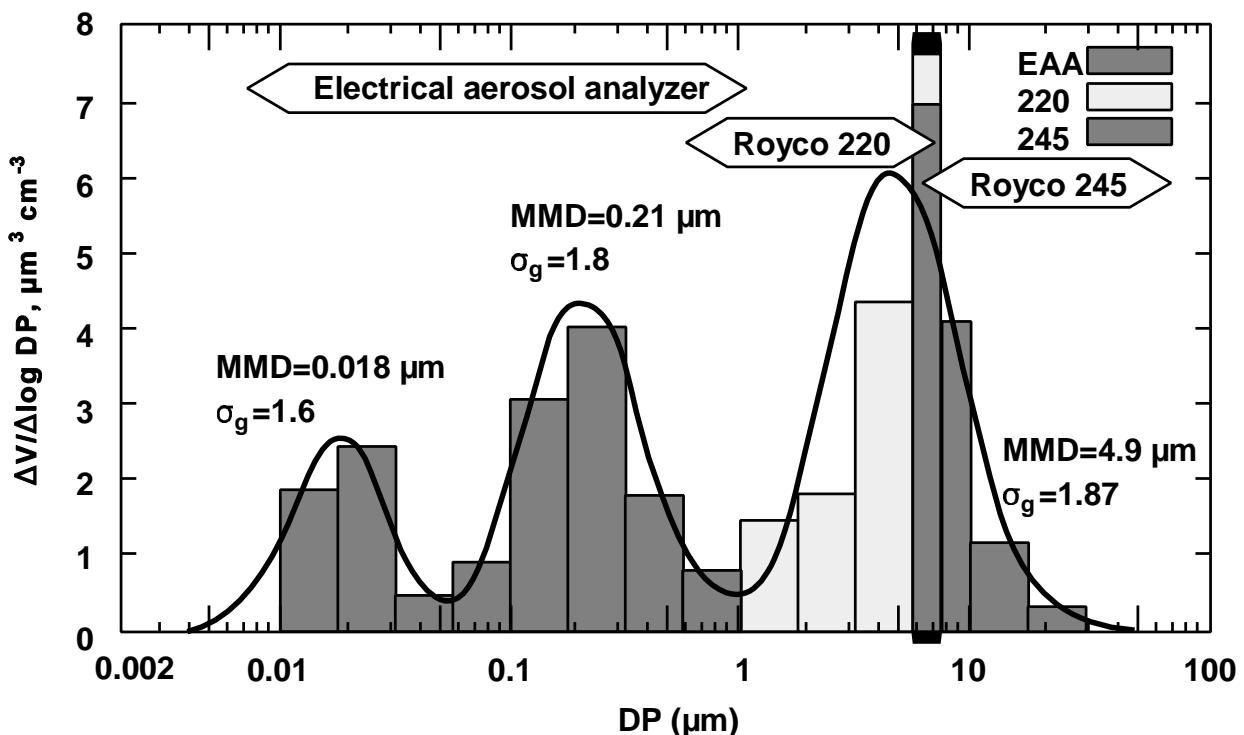




## **APPENDIX 10C**

### **SELECTED AMBIENT AEROSOL PARTICLE DISTRIBUTIONS**



**Figure 10C-1.** An example of histogram display and fitting to log-normal functions for particle-counting size distribution data. Instruments used and the range covered by each are shown. Counts are combined into reasonably-sized bins and displayed. Lognormal functions, fitted to the data, are shown with geometric mass median diameter (MMD) of each mode and the width ( $\sigma_g$ ) of each mode. Data taken from a study of fine sulfate and other particles generated by catalyst equipped cars as part of a cooperative study by EPA and General Motors Corporation. Note the clear separation of the nuclei mode (MMD = 0.018  $\mu\text{m}$ ), the accumulation mode (MMD = 0.21  $\mu\text{m}$ ) and coarse mode (MMD = 4.9  $\mu\text{m}$ ). Fine particles, as defined by Whitby (1978), include the nuclei and accumulation mode.

Source: Wilson et al. (1977).

**TABLE 10C-1 DISTRIBUTION OF PARTICLE COUNT, SURFACE AREA OR MASS IN THE TRIMODAL POLYDISPERSE AEROSOL DEFINED IN FIGURE 10C-1**

(The tabulated numbers represent the upper size cut [in  $\mu\text{m}$ ] for each particle size interval based on the distribution of particle count vs. physical diameter [ $d_p\{\text{c}\}$ ], distribution of surface area vs. physical diameter [ $d_p\{\text{s}\}$ ], distribution of mass vs. physical diameter [ $d_p\{\text{m}\}$ ], or distribution of mass vs. Aerodynamic diameter [ $d_{ae}\{\text{m}\}$ ]).<sup>a</sup>)

Aerosol Mode	Particle Parameter	Percent of Total Count, Surface Area or Mass Associated with Particles Smaller than Size Cut												
		1	5	10	20	30	40	50	60	70	80	90	95	99
Accumulation <sup>b</sup>	count; $d_p\{\text{c}\}$	0.0053	0.0073	0.0087	0.011	0.012	0.014	0.016	0.018	0.020	0.024	0.029	0.034	0.047
	surface; $d_p\{\text{s}\}$	0.0058	0.0080	0.0094	0.012	0.013	0.015	0.017	0.019	0.022	0.026	0.032	0.037	0.051
	mass; $d_p\{\text{m}\}$	0.0060	0.0083	0.010	0.012	0.014	0.016	0.018	0.020	0.023	0.027	0.033	0.039	0.054
	mass; $d_{ae}\{\text{m}\}$	0.0056	0.078	0.093	0.011	0.013	0.015	0.017	0.019	0.022	0.025	0.031	0.037	0.051
Intermodal <sup>c</sup>	count; $d_p\{\text{c}\}$	0.044	0.066	0.081	0.105	0.127	0.149	0.173	0.201	0.235	0.283	0.367	0.454	0.676
	surface; $d_p\{\text{s}\}$	0.050	0.075	0.093	0.120	0.145	0.170	0.197	0.228	0.268	0.323	0.418	0.517	0.768
	mass; $d_p\{\text{m}\}$	0.053	0.080	0.099	0.128	0.154	0.181	0.210	0.244	0.286	0.345	0.447	0.551	0.820
	mass; $d_{ae}\{\text{m}\}$	0.044	0.066	0.083	0.108	0.131	0.155	0.180	0.211	0.248	0.301	0.437	0.485	0.725
Coarse <sup>d</sup>	count; $d_p\{\text{c}\}$	0.915	1.40	1.76	2.32	2.83	3.35	3.93	4.60	5.45	6.66	8.76	11.0	16.8
	surface; $d_p\{\text{s}\}$	1.06	1.63	2.04	2.69	3.28	3.88	4.55	5.34	6.32	7.71	10.2	12.7	19.5
	mass; $d_p\{\text{m}\}$	1.14	1.75	2.20	2.89	3.53	4.18	4.90	5.75	6.81	8.30	10.9	13.7	20.9
	mass; $d_{ae}\{\text{m}\}$	1.40	2.14	2.68	3.52	4.29	5.08	5.95	6.98	8.27	10.1	13.2	16.6	25.3

<sup>a</sup>Values for  $d_{ae}$  were calculated iteratively from  $d_p$  using Equations D.13 and D.14 of ICRP Publication 66, Annexe D (James *et al.*, 1994).

<sup>b</sup>Mass median aerodynamic diameter (MMAD) = 0.018  $\mu\text{m}$ ; geometric standard deviation ( $\sigma_g$ ) = 1.6; density ( $\rho$ ) = 1.4  $\text{g}/\text{cm}^3$ .

<sup>c</sup>MMAD = 0.21  $\mu\text{m}$ ;  $\sigma_g$  = 1.8;  $\rho$  = 1.2  $\text{g}/\text{cm}^3$ .

<sup>d</sup>MMAD = 4.9  $\mu\text{m}$ ;  $\sigma_g$  = 1.87;  $\rho$  = 2.2  $\text{g}/\text{cm}^3$ .

**TABLE 10C-2a. DISTRIBUTION OF PARTICLE NUMBER IN THE TRIMODAL POLYDISPERSE AEROSOL DEFINED IN FIGURE 10C-1**  
 (Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% number fractiles.  
 The “nuclei mode” contains about 99.6% of the total number of particles; the “accumulation mode” about 0.39%; and the “coarse mode” about 0.01%.)

Mode	Number Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Nuclei <sup>a</sup>	1	1.0	0.0027
	5	4.0	0.0038
	10	5.0	0.0045
	20	10	0.0055
	30	10	0.0064
	40	10	0.0073
	50	10	0.0082
	60	10	0.0092
	70	10	0.0105
	80	10	0.0122
	90	10	0.0149
	95	5.0	0.0177
	99	4.0	0.0244
Accumulation <sup>b</sup>	1	0.004	0.0156
	5	0.0159	0.0233
	10	0.0198	0.0289
	20	0.0397	0.0374
	30	0.0397	0.0450
	40	0.0397	0.0528
	50	0.0397	0.0613
	60	0.0397	0.0711
	70	0.0397	0.0834
	80	0.0397	0.101
	90	0.0397	0.130
	95	0.0198	0.161
	99	0.0159	0.241

**TABLE 10C-2a (cont'd). DISTRIBUTION OF PARTICLE NUMBER IN THE TRIMODAL POLYDISPERSE AEROSOL DEFINED IN FIGURE 10C-1**  
**(Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% number fractiles.**  
**The “nuclei mode” contains about 99.6% of the total number of particles;**  
**the “accumulation mode” about 0.39%; and the “coarse mode” about 0.01%.)**

Mode	Number Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Coarse <sup>c</sup>	1	$2.7 \times 10^{-7}$	0.283
	5	$1.1 \times 10^{-6}$	0.432
	10	$1.3 \times 10^{-6}$	0.543
	20	$2.7 \times 10^{-6}$	0.716
	30	$2.7 \times 10^{-6}$	0.873
	40	$2.7 \times 10^{-6}$	1.03
	50	$2.7 \times 10^{-6}$	1.21
	60	$2.7 \times 10^{-6}$	1.42
	70	$2.7 \times 10^{-6}$	1.68
	80	$2.7 \times 10^{-6}$	2.05
	90	$2.7 \times 10^{-6}$	2.71
	95	$1.3 \times 10^{-6}$	3.40
	99	$1.1 \times 10^{-6}$	5.21

<sup>a</sup>Mass median diameter (MMD) = 0.018  $\mu\text{m}$ ; geometric standard deviation ( $\sigma_g$ ) = 1.6; density ( $\rho$ ) = 1.4 g/cm<sup>3</sup>.

<sup>b</sup>MMD = 0.21  $\mu\text{m}$ ;  $\sigma_g$  = 1.8; density ( $\rho$ ) = 1.2 g/cm<sup>3</sup>.

<sup>c</sup>MMD = 4.9  $\mu\text{m}$ ;  $\sigma_g$  = 1.87; density ( $\rho$ ) = 2.2 g/cm<sup>3</sup>.

**TABLE 10C-2b. DISTRIBUTION OF PARTICLE SURFACE AREA IN THE TRIMODAL POLYDISPERSE AEROSOL DEFINED IN FIGURE 10C-1**  
**(Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% surface area fractiles.**  
**The “nuclei mode” contains about 77.4% of the total particle surface area; the “accumulation mode” about 21.9%; and the “coarse mode” about 0.64%.)**

Mode	Surface Area Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Nuclei <sup>a</sup>	1	0.78	0.0043
	5	3.1	0.0059
	10	3.9	0.0070
	20	7.8	0.0086
	30	7.8	0.0100
	40	7.8	0.0113
	50	7.8	0.0127
	60	7.8	0.0144
	70	7.8	0.0163
	80	7.8	0.0189
	90	7.8	0.0233
Accumulation <sup>b</sup>	95	3.9	0.0277
	99	3.1	0.0381
	1	0.22	0.0312
	5	0.89	0.0465
	10	1.1	0.0575
	20	2.2	0.0746
	30	2.2	0.0899
	40	2.2	0.105
	50	2.2	0.122
	60	2.2	0.142
	70	2.2	0.167
Coarse	80	2.2	0.201
	90	2.2	0.260
	95	1.1	0.322
	99	0.89	0.481

**TABLE 10C-2b (cont'd). DISTRIBUTION OF PARTICLE SURFACE AREA IN THE TRIMODAL POLYDISPERSE AEROSOL DEFINED IN FIGURE 10C-1**

(Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% surface area fractiles.

The “nuclei mode” contains about 77.4% of the total particle surface area; the “accumulation mode” about 21.9%; and the “coarse mode” about 0.64%.)

Mode	Number Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Coarse <sup>c</sup>	1	0.006	0.618
	5	0.026	0.947
	10	0.032	1.19
	20	0.064	1.57
	30	0.064	1.91
	40	0.064	2.27
	50	0.064	2.65
	60	0.064	3.11
	70	0.064	3.69
	80	0.064	4.50
	90	0.064	5.92
	95	0.032	7.44
	99	0.026	11.4

<sup>a</sup>Mass median diameter (MMD) = 0.018  $\mu\text{m}$ ; geometric standard deviation ( $\sigma_g$ ) = 1.6; density ( $\rho$ ) = 1.4 g/cm<sup>3</sup>.

<sup>b</sup>MMD = 0.21  $\mu\text{m}$ ;  $\sigma_g$  = 1.8; density ( $\rho$ ) = 1.2 g/cm<sup>3</sup>.

<sup>c</sup>MMD = 4.9  $\mu\text{m}$ ;  $\sigma_g$  = 1.87; density ( $\rho$ ) = 2.2 g/cm<sup>3</sup>.

**TABLE 10C-2c. DISTRIBUTION OF PARTICLE MASS IN THE TRIMODAL POLYDISPERSE AEROSOL DEFINED IN FIGURE 10C-1**  
**(Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% mass fractiles. The “nuclei mode” contains 15.6% of the total particle mass; the “accumulation mode” 38.7%; and the “coarse mode” about 45.7%.)**

Mode	Mass Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Nuclei <sup>a</sup>	1	0.16	0.0053
	5	0.63	0.0073
	10	0.79	0.0087
	20	1.58	0.0107
	30	1.58	0.0124
	40	1.58	0.0141
	50	1.58	0.0159
	60	1.58	0.0179
	70	1.58	0.0203
	80	1.58	0.0236
	90	1.58	0.0290
Accumulation <sup>b</sup>	95	0.79	0.0345
	99	0.63	0.0474
	1	0.39	0.0312
	5	1.56	0.0465
	10	1.95	0.0575
	20	3.91	0.0746
	30	3.91	0.0899
	40	3.91	0.105
	50	3.91	0.122
	60	3.91	0.142
	70	3.91	0.167
Coarse	80	3.91	0.201
	90	3.91	0.260
	95	1.95	0.322
	99	1.56	0.481

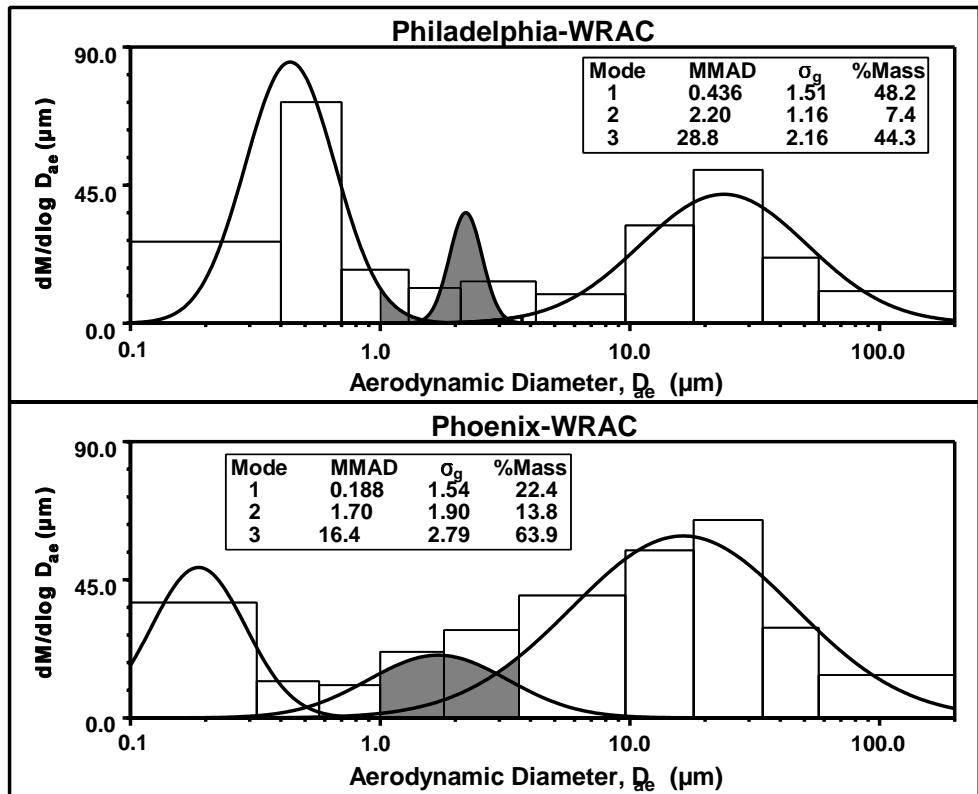
**TABLE 10C-2c (cont'd). DISTRIBUTION OF PARTICLE MASS IN THE TRIMODAL POLYDISPERSE AEROSOL DEFINED IN FIGURE 10C-1**  
**(Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% mass fractiles. The “nuclei mode” contains 15.6% of the total particle mass; the “accumulation mode” about 38.7%; and the “coarse mode” about 45.7%.)**

Mode	Number Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Coarse <sup>c</sup>	1	0.46	0.915
	5	1.85	1.40
	10	2.31	1.76
	20	4.62	2.32
	30	4.62	2.83
	40	4.62	3.35
	50	4.62	3.93
	60	4.62	4.60
	70	4.62	5.45
	80	4.62	6.66
	90	4.62	8.76
	95	2.31	11.0
	99	1.85	16.9

<sup>a</sup>Mass median diameter (MMD) = 0.018  $\mu\text{m}$ ; geometric standard deviation ( $\sigma_g$ ) = 1.6; density ( $\rho$ ) = 1.4 g/cm<sup>3</sup>.

<sup>b</sup>MMD = 0.21  $\mu\text{m}$ ;  $\sigma_g$  = 1.8; density ( $\rho$ ) = 1.2 g/cm<sup>3</sup>.

<sup>c</sup>MMD = 4.9  $\mu\text{m}$ ;  $\sigma_g$  = 1.87; density ( $\rho$ ) = 2.2 g/cm<sup>3</sup>.



**Figure 10C-2.** Impactor size distribution measurement generated by Lundgren et al. with the Wide Range Aerosol Classifier: (a) Philadelphia and (b) Phoenix. Note the much larger, small size tail to the coarse mode in the dryer environment of Phoenix.

Source: Lundgren and Hausknecht (1982).

**TABLE 10C-3. DISTRIBUTION OF PARTICLE COUNT, SURFACE AREA OR MASS IN THE TRIMODAL POLYDISPERSE AEROSOL FOR PHILADELPHIA DEFINED IN FIGURE 10C-2(a)**

(The tabulated numbers represent the upper size cut [in  $\mu\text{m}$ ] for each particle size interval based on the distribution of particle count vs. aerodynamic diameter [ $d_{\text{ae}}\{\text{c}\}$ ], distribution of surface area vs. aerodynamic diameter [ $d_{\text{ae}}\{\text{s}\}$ ], distribution of mass vs. aerodynamic diameter [ $d_{\text{ae}}\{\text{m}\}$ ], or distribution of mass vs. equivalent physical diameter [ $d_p\{\text{m}\}$ ]<sup>a</sup>.)

Aerosol Mode	Particle Parameter	Percent of Total Count, Surface Area or Mass Associated with Particles Smaller than Size Cut												
		1	5	10	20	30	40	50	60	70	80	90	95	99
Accumulation <sup>b</sup>	count; $d_{\text{ae}}\{\text{c}\}$	0.152	0.201	0.233	0.280	0.319	0.357	0.396	0.440	0.492	0.561	0.673	0.781	1.03
	surface; $d_{\text{ae}}\{\text{s}\}$	0.162	0.214	0.249	0.298	0.340	0.381	0.422	0.469	0.525	0.597	0.717	0.831	1.10
	mass; $d_{\text{ae}}\{\text{m}\}$	0.167	0.221	0.257	0.308	0.351	0.393	0.436	0.484	0.541	0.618	0.741	0.860	1.13
	mass; $d_p\{\text{m}\}$	0.185	0.243	0.282	0.336	0.383	0.428	0.474	0.526	0.587	0.670	0.802	0.930	1.22
Intermodal <sup>c</sup>	count; $d_{\text{ae}}\{\text{c}\}$	1.53	1.70	1.79	1.92	2.01	2.09	2.17	2.26	2.35	2.47	2.63	2.78	3.06
	surface; $d_{\text{ae}}\{\text{s}\}$	1.54	1.72	1.80	1.93	2.03	2.11	2.19	2.28	2.37	2.49	2.66	2.80	3.09
	mass; $d_{\text{ae}}\{\text{m}\}$	1.55	1.73	1.81	1.94	2.04	2.12	2.20	2.29	2.38	2.50	2.67	2.81	3.11
	mass; $d_p\{\text{m}\}$	1.67	1.86	1.95	2.09	2.20	2.28	2.37	2.47	2.56	2.69	2.87	3.02	3.34
Coarse <sup>d</sup>	count; $d_{\text{ae}}\{\text{c}\}$	3.43	5.80	7.67	10.8	13.8	16.9	20.6	25.0	30.8	39.4	55.3	73.1	122.5
	surface; $d_{\text{ae}}\{\text{s}\}$	4.29	7.25	9.60	13.5	17.2	21.2	25.7	31.3	38.6	49.2	69.0	91.4	153.5
	mass; $d_{\text{ae}}\{\text{m}\}$	4.80	8.12	10.7	15.1	19.2	23.7	28.8	35.0	43.2	55.1	77.3	102.1	171.5
	Mass; $d_p\{\text{m}\}$	5.16	8.73	11.5	16.2	20.6	25.5	30.9	37.6	46.4	59.2	83.0	109.7	184.2

<sup>a</sup>Values for  $d_p$  were calculated iteratively from  $d_{\text{ae}}$  using Equations D.13 and D.14 of ICRP Publication 66, Annex D (James *et al.*, 1994).

<sup>b</sup>Mass median aerodynamic diameter (MMAD) = 0.436  $\mu\text{m}$ ; geometric standard deviation ( $\sigma_g$ ) = 1.51; density ( $\rho$ ) = 1.3 g/cm<sup>3</sup>.

<sup>c</sup>MMAD = 2.20  $\mu\text{m}$ ;  $\sigma_g$  = 1.16;  $\rho$  = 1.3 g/cm<sup>3</sup>.

<sup>d</sup>MMAD = 28.8  $\mu\text{m}$ ;  $\sigma_g$  = 2.16;  $\rho$  = 1.3 g/cm<sup>3</sup>.

**TABLE 10C-4a. DISTRIBUTION OF PARTICLE NUMBER IN THE TRIMODAL POLYDISPERSE PHILADELPHIA AEROSOL DEFINED IN FIGURE 10C-2a (Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% number fractiles. The “accumulation mode” contains about 99.95% of the total number of particles; the “intermodal mode” about 0.05%; and the “coarse mode” about 0.004%.)**

Mode	Number Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Accumulation <sup>a</sup>	1	1.0	0.0912
	5	4.0	0.121
	10	5.0	0.140
	20	10	0.168
	30	10	0.192
	40	10	0.215
	50	10	0.238
	60	10	0.264
	70	10	0.296
	80	10	0.337
	90	10	0.404
Intermodal <sup>b</sup>	95	5.0	0.469
	99	4.0	0.623
	1	$4.8 \times 10^{-4}$	1.43
	5	$1.9 \times 10^{-3}$	1.60
	10	$2.4 \times 10^{-3}$	1.68
	20	$4.8 \times 10^{-3}$	1.79
	30	$4.8 \times 10^{-3}$	1.88
	40	$4.8 \times 10^{-3}$	1.96
	50	$4.8 \times 10^{-3}$	2.03
	60	$4.8 \times 10^{-3}$	2.12
	70	$4.8 \times 10^{-3}$	2.20
Coarse	80	$4.8 \times 10^{-3}$	2.31
	90	$4.8 \times 10^{-3}$	2.47
	95	$2.4 \times 10^{-3}$	2.59
	99	$1.9 \times 10^{-3}$	2.89

**TABLE 10C-4a (cont'd). DISTRIBUTION OF PARTICLE NUMBER IN THE TRIMODAL POLYDISPERSE PHILADELPHIA AEROSOL DEFINED IN**

**FIGURE 10C-2a (Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% number fractiles. The “accumulation mode” contains about 99.95% of the total number of particles; the “intermodal mode” about 0.05%; and the “coarse mode” about 0.004%.)**

Mode	Number Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Coarse <sup>c</sup>	1	$4.4 \times 10^{-5}$	0.579
	5	$1.8 \times 10^{-4}$	0.979
	10	$2.2 \times 10^{-4}$	1.30
	20	$4.4 \times 10^{-4}$	1.82
	30	$4.4 \times 10^{-4}$	2.32
	40	$4.4 \times 10^{-4}$	2.86
	50	$4.4 \times 10^{-4}$	3.48
	60	$4.4 \times 10^{-4}$	4.22
	70	$4.4 \times 10^{-4}$	5.21
	80	$4.4 \times 10^{-4}$	6.65
	90	$4.4 \times 10^{-4}$	9.34
Intermodal <sup>b</sup>	95	$2.2 \times 10^{-4}$	12.3
	99	$1.8 \times 10^{-4}$	20.9

<sup>a</sup>Mass median aerodynamic diameter (MMAD) = 0.436  $\mu\text{m}$ ; geometric standard deviation ( $\sigma_g$ ) = 1.51; density ( $\rho$ ) = 1.3 g/cm<sup>3</sup>.

<sup>b</sup>MMAD = 2.20  $\mu\text{m}$ ;  $\sigma_g$  = 1.16; density ( $\rho$ ) = 1.3 g/cm<sup>3</sup>.

<sup>c</sup>MMAD = 28.8  $\mu\text{m}$ ;  $\sigma_g$  = 2.16; density ( $\rho$ ) = 1.3 g/cm<sup>3</sup>.

**TABLE 10C-4b. DISTRIBUTION OF PARTICLE SURFACE AREA IN THE TRIMODAL POLYDISPERSE PHILADELPHIA AEROSOL DEFINED IN**

**FIGURE 10C-2a (Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% surface area fractiles. The “accumulation mode” contains about 95.4% of the total particle surface area; the “intermodal mode” about 2.5%; and the “coarse mode” about 2.1%).**

Mode	Surface Area Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Accumulation <sup>a</sup>	1	0.96	0.128
	5	3.9	0.170
	10	4.8	0.197
	20	9.6	0.236
	30	9.6	0.269
	40	9.6	0.301
	50	9.6	0.334
	60	9.6	0.371
	70	9.6	0.415
	80	9.6	0.473
	90	9.6	0.568
Intermodal <sup>b</sup>	95	4.8	0.659
	99	3.9	0.875
	1	0.025	1.50
	5	0.10	1.66
	10	0.13	1.75
	20	0.25	1.88
	30	0.25	1.96
	40	0.25	2.05
	50	0.25	2.13
	60	0.25	2.21
	70	0.25	2.30
Coarse	80	0.25	2.41
	90	0.25	2.57
	95	0.13	2.73
Mode	99	0.10	3.02

**TABLE 10C-4b (cont'd). DISTRIBUTION OF PARTICLE SURFACE AREA IN THE TRIMODAL POLYDISPERSE PHILADELPHIA AEROSOL DEFINED IN FIGURE 10C-2a** (Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% surface area fractiles. The “accumulation mode” contains about 95.4% of the total particle surface area; the “intermodal mode” about 2.5%; and the “coarse mode” about 2.1%).

Mode	Surface Area Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Coarse <sup>c</sup>	1	0.02	1.90
	5	0.08	3.20
	10	0.11	4.24
	20	0.21	5.95
	30	0.21	7.60
	40	0.21	9.37
	50	0.21	11.4
	60	0.21	13.8
	70	0.21	17.0
	80	0.21	21.8
	90	0.21	30.5
Intermodal <sup>b</sup>	95	0.11	40.4
	99	0.08	68.1

<sup>a</sup>Mass median aerodynamic diameter (MMAD) = 0.436  $\mu\text{m}$ ; geometric standard deviation ( $\sigma_g$ ) = 1.51; density ( $\rho$ ) = 1.3 g/cm<sup>3</sup>.

<sup>b</sup>MMAD = 2.20  $\mu\text{m}$ ;  $\sigma_g$  = 1.16; density ( $\rho$ ) = 1.3 g/cm<sup>3</sup>.

<sup>c</sup>MMAD = 28.8  $\mu\text{m}$ ;  $\sigma_g$  = 2.16; density ( $\rho$ ) = 1.3 g/cm<sup>3</sup>.

**TABLE 10C-4c. DISTRIBUTION OF PARTICLE MASS IN THE TRIMODAL POLYDISPERSE PHILADELPHIA AEROSOL DEFINED IN FIGURE 10C-2a (Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% mass fractiles. The “accumulation mode” contains 48.2% of the total particle mass; the “intermodal mode” 7.4%; and the “coarse mode” 44.3%).**

Mode	Mass Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Accumulation <sup>a</sup>	1	0.49	0.152
	5	2.0	0.201
	10	2.4	0.233
	20	4.9	0.280
	30	4.9	0.319
	40	4.9	0.357
	50	4.9	0.396
	60	4.9	0.440
	70	4.9	0.492
	80	4.9	0.561
	90	4.9	0.673
Intermodal <sup>b</sup>	95	2.4	0.782
	99	2.0	1.04
	1	0.07	1.53
	5	0.30	1.70
	10	0.37	1.79
	20	0.75	1.92
	30	0.75	2.01
	40	0.75	2.09
	50	0.75	2.17
	60	0.75	2.26
	70	0.75	2.35
Coarse	80	0.75	2.47
	90	0.75	2.63
	95	0.37	2.78
	99	0.30	3.06

**TABLE 10C-4c (cont'd). DISTRIBUTION OF PARTICLE MASS IN THE TRIMODAL POLYDISPERSE PHILADELPHIA AEROSOL DEFINED IN FIGURE 10C-2a** (Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% mass fractiles. The “accumulation mode” contains 48.2% of the total particle mass; the “intermodal mode” 7.4%; and the “coarse mode” 44.3%).

Mode	Mass Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Coarse <sup>c</sup>	1	0.45	3.43
	5	1.8	5.80
	10	2.2	7.67
	20	4.5	10.8
	30	4.5	13.7
	40	4.5	16.9
	50	4.5	20.6
	60	4.5	25.0
	70	4.5	30.8
	80	4.5	39.2
	90	4.5	55.0
Intermodal <sup>b</sup>	95	2.2	72.4
	99	1.8	118.7

<sup>a</sup>Mass median aerodynamic diameter (MMAD) = 0.436  $\mu\text{m}$ ; geometric standard deviation ( $\sigma_g$ ) = 1.51; density ( $\rho$ ) = 1.3 g/cm<sup>3</sup>.

<sup>b</sup>MMAD = 2.20  $\mu\text{m}$ ;  $\sigma_g$  = 1.16; density ( $\rho$ ) = 1.3 g/cm<sup>3</sup>.

<sup>c</sup>MMAD = 28.8  $\mu\text{m}$ ;  $\sigma_g$  = 2.16; density ( $\rho$ ) = 1.3 g/cm<sup>3</sup>.

**TABLE 10C-5. DISTRIBUTION OF PARTICLE COUNT, SURFACE AREA OR MASS IN THE TRIMODAL POLYDISPERSE AEROSOL FOR PHOENIX DEFINED IN FIGURE 10C-2(b) (The tabulated numbers represent the upper size cut [in  $\mu\text{m}$ ] for each particle size interval based on the distribution of particle count vs. aerodynamic diameter [ $d_{\text{ae}}\{\text{c}\}$ ], distribution of surface area vs. aerodynamic diameter [ $d_{\text{ae}}\{\text{s}\}$ ], distribution of mass vs. aerodynamic diameter [ $d_{\text{ae}}\{\text{m}\}$ ], or distribution of mass vs. equivalent physical diameter [ $d_p\{\text{m}\}$ ]<sup>a</sup>.)**

Aerosol Mode	Particle Parameter	Percent of Total Count, Surface Area or Mass Associated with Particles Smaller than Size Cut												
		1	5	10	20	30	40	50	60	70	80	90	95	99
Accumulation <sup>b</sup>	count; $d_{\text{ae}}\{\text{c}\}$	0.062	0.083	0.097	0.118	0.135	0.152	0.169	0.189	0.212	0.243	0.295	0.345	0.461
	surface; $d_{\text{ae}}\{\text{s}\}$	0.066	0.089	0.104	0.126	0.145	0.163	0.182	0.203	0.228	0.261	0.316	0.369	0.495
	mass; $d_{\text{ae}}\{\text{m}\}$	0.069	0.092	0.108	0.131	0.150	0.169	0.188	0.210	0.236	0.271	0.327	0.383	0.511
	mass; $d_p\{\text{m}\}$	0.062	0.083	0.098	0.119	0.137	0.155	0.172	0.193	0.217	0.250	0.303	0.355	0.475
Intermodal <sup>c</sup>	count; $d_{\text{ae}}\{\text{c}\}$	0.302	0.469	0.592	0.785	0.962	1.14	1.35	1.58	1.89	2.31	3.06	3.87	5.96
	surface; $d_{\text{ae}}\{\text{s}\}$	0.353	0.548	0.691	0.916	1.12	1.34	1.57	1.85	2.20	2.70	3.58	4.52	6.95
	mass; $d_{\text{ae}}\{\text{m}\}$	0.381	0.592	0.747	0.991	1.21	1.45	1.70	2.00	2.38	2.91	3.87	4.89	7.52
	mass; $d_p\{\text{m}\}$	0.353	0.552	0.697	0.926	1.13	1.36	1.59	1.87	2.23	2.73	3.63	4.59	7.06
Coarse <sup>d</sup>	count; $d_{\text{ae}}\{\text{c}\}$	0.831	1.67	2.43	3.81	5.28	6.97	9.04	11.7	15.5	21.4	33.7	48.8	97.4
	surface; $d_{\text{ae}}\{\text{s}\}$	1.24	2.49	3.61	5.67	7.85	10.4	13.4	17.4	23.0	31.9	50.0	72.6	144.8
	mass; $d_{\text{ae}}\{\text{m}\}$	1.51	3.03	4.40	6.92	9.58	12.7	16.4	21.3	28.1	38.9	61.1	88.4	176.9
	mass; $d_p\{\text{m}\}$	1.41	2.34	4.13	6.50	8.99	11.9	15.4	20.0	26.4	36.5	57.4	83.0	166.2

<sup>a</sup>Values for  $d_p$  were calculated iteratively from  $d_{\text{ae}}$  using Equations D.13 and D.14 of ICRP Publication 66, Annex D (James *et al.*, 1994).

<sup>b</sup>Mass median aerodynamic diameter (MMAD) = 0.188  $\mu\text{m}$ ; geometric standard deviation ( $\sigma_g$ ) = 1.54; density ( $\rho$ ) = 1.7 g/cm<sup>3</sup>.

<sup>c</sup>MMAD = 1.70  $\mu\text{m}$ ;  $\sigma_g$  = 1.90;  $\rho$  = 1.7 g/cm<sup>3</sup>.

<sup>d</sup>MMAD = 16.4  $\mu\text{m}$ ;  $\sigma_g$  = 2.79;  $\rho$  = 1.7 g/cm<sup>3</sup>.

**TABLE 10C-6a. DISTRIBUTION OF PARTICLE NUMBER IN THE TRIMODAL POLYDISPERSE PHOENIX AEROSOL DEFINED IN FIGURE 10C-2b**  
 (Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% number fractiles. The “accumulation mode” contains about 99.6% of the total number of particles; the “intermodal mode” about 0.3%; and the “coarse mode” about 0.1%.)

Mode	Number Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Accumulation <sup>a</sup>	1	1.0	0.0353
	5	4.0	0.0475
	10	5.0	0.0556
	20	10	0.0672
	30	10	0.0771
	40	10	0.0867
	50	10	0.0967
	60	10	0.108
	70	10	0.122
	80	10	0.139
	90	10	0.169
	95	5.0	0.197
Intermodal <sup>b</sup>	99	4.0	0.264
	1	0.0034	0.0878
	5	0.014	0.136
	10	0.017	0.172
	20	0.034	0.228
	30	0.034	0.280
	40	0.034	0.333
	50	0.034	0.391
	60	0.034	0.461
	70	0.034	0.548
	80	0.034	0.673
	90	0.034	0.891
Coarse	95	0.017	1.13
	99	0.014	1.74

**TABLE 10C-6a (cont'd). DISTRIBUTION OF PARTICLE NUMBER IN THE TRIMODAL POLYDISPERSE PHOENIX AEROSOL DEFINED IN FIGURE 10C-2b**  
 (Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% number fractiles. The “accumulation mode” contains about 99.6% of the total number of particles; the “intermodal mode” about 0.3%; and the “coarse mode” about 0.1%.)

Mode	Number Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Coarse <sup>c</sup>	1	$9.3 \times 10^{-4}$	0.0353
	5	$3.7 \times 10^{-3}$	0.0711
	10	$4.6 \times 10^{-3}$	0.103
	20	$9.3 \times 10^{-3}$	0.162
	30	$9.3 \times 10^{-3}$	0.224
	40	$9.3 \times 10^{-3}$	0.296
	50	$9.3 \times 10^{-3}$	0.385
	60	$9.3 \times 10^{-3}$	0.499
	70	$9.3 \times 10^{-3}$	0.658
	80	$9.3 \times 10^{-3}$	0.912
	90	$9.3 \times 10^{-3}$	1.43
	95	$4.6 \times 10^{-3}$	2.08
	99	$3.7 \times 10^{-3}$	4.18

<sup>a</sup>Mass median aerodynamic diameter (MMAD) = 0.188  $\mu\text{m}$ ; geometric standard deviation ( $\sigma_g$ ) = 1.54; density ( $\rho$ ) = 1.7 g/cm<sup>3</sup>.

<sup>b</sup>MMAD = 1.70  $\mu\text{m}$ ;  $\sigma_g$  = 1.90; density ( $\rho$ ) = 1.7 g/cm<sup>3</sup>.

<sup>c</sup>MMAD = 16.4  $\mu\text{m}$ ;  $\sigma_g$  = 2.79; density ( $\rho$ ) = 1.7 g/cm<sup>3</sup>.

**TABLE 10C-6b. DISTRIBUTION OF PARTICLE SURFACE AREA IN THE TRIMODAL POLYDISPERSE PHOENIX AEROSOL DEFINED IN FIGURE 10C-2b**

(Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% surface area fractiles. The “accumulation mode” contains about 85.5% of the total particle surface area; the “intermodal mode” about 7.4%; and the “coarse mode” about 7.0%.)

Mode	Surface Area Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Accumulation <sup>a</sup>	1	0.86	0.0514
	5	3.5	0.0689
	10	4.3	0.0807
	20	8.6	0.0977
	30	8.6	0.112
	40	8.6	0.126
	50	8.6	0.141
	60	8.6	0.157
	70	8.6	0.176
	80	8.6	0.202
	90	8.6	0.244
Intermodal <sup>b</sup>	95	4.3	0.285
	99	3.5	0.385
	1	0.075	0.202
	5	0.30	0.311
	10	0.37	0.392
	20	0.75	0.520
	30	0.75	0.637
	40	0.75	0.758
	50	0.75	0.892
	60	0.75	1.05
	70	0.75	1.25
Coarse	80	0.75	1.53
	90	0.75	2.03
	95	0.37	2.57
	99	0.30	3.97

**TABLE 10C-6b (cont'd). DISTRIBUTION OF PARTICLE SURFACE AREA IN THE TRIMODAL POLYDISPERSE PHOENIX AEROSOL DEFINED IN FIGURE 10C-2b**

(Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% surface area fractiles.

The “accumulation mode” contains about 85.5% of the total particle surface area; the “intermodal mode” about 7.4%; and the “coarse mode” about 7.0%).

Mode	Surface Area Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Coarse <sup>c</sup>	1	0.07	0.290
	5	0.29	0.583
	10	0.36	0.847
	20	0.71	1.33
	30	0.71	1.84
	40	0.71	2.43
	50	0.71	3.16
	60	0.71	4.09
	70	0.71	5.40
	80	0.71	7.48
	90	0.71	11.8
Intermodal <sup>b</sup>	95	0.36	17.1
	99	0.29	34.4

<sup>a</sup>Mass median aerodynamic diameter (MMAD) = 0.188  $\mu\text{m}$ ; geometric standard deviation ( $\sigma_g$ ) = 1.54; density ( $\rho$ ) = 1.7 g/cm<sup>3</sup>.

<sup>b</sup>MMAD = 1.70  $\mu\text{m}$ ;  $\sigma_g$  = 1.90; density ( $\rho$ ) = 1.7 g/cm<sup>3</sup>.

<sup>c</sup>MMAD = 16.4  $\mu\text{m}$ ;  $\sigma_g$  = 2.79; density ( $\rho$ ) = 1.7 g/cm<sup>3</sup>.

**TABLE 10C-6c. DISTRIBUTION OF PARTICLE MASS IN THE TRIMODAL POLYDISPERSE PHOENIX AEROSOL DEFINED IN FIGURE 10C-2b**  
**(Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% mass fractiles. The “accumulation mode” contains 22.4% of the total particle mass; the “intermodal mode” 13.8%; and the “coarse mode” 63.9%.)**

Mode	Mass Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Accumulation <sup>a</sup>	1	0.23	0.0618
	5	0.91	0.0832
	10	1.1	0.0973
	20	2.3	0.118
	30	2.3	0.135
	40	2.3	0.152
	50	2.3	0.169
	60	2.3	0.189
	70	2.3	0.213
	80	2.3	0.243
	90	2.3	0.295
	95	1.1	0.345
Intermodal <sup>b</sup>	99	0.91	0.462
	1	0.14	0.302
	5	0.56	0.469
	10	0.70	0.592
	20	1.4	0.785
	30	1.4	0.962
	40	1.4	1.14
	50	1.4	1.35
	60	1.4	1.58
	70	1.4	1.89
	80	1.4	2.31
	90	1.4	3.06
Coarse	95	0.70	3.87
	99	0.56	6.00

**TABLE 10C-6c (cont'd). DISTRIBUTION OF PARTICLE MASS IN THE TRIMODAL POLYDISPERSE PHOENIX AEROSOL DEFINED IN FIGURE 10C-2b**  
**(Each individual mode of the trimodal aerosol is separated into the size fractions containing the 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, and 99% mass fractiles. The “accumulation mode” contains 22.4% of the total particle mass; the “intermodal mode” 13.8%; and the “coarse mode” 63.9%.)**

Mode	Mass Fractile (%)	Percent of Trimodal Aerosol	Upper Limit of Particle Size Interval ( $\mu\text{m}$ )
Coarse <sup>c</sup>	1	0.65	0.831
	5	2.6	1.67
	10	3.2	2.43
	20	6.5	3.81
	30	6.5	5.27
	40	6.5	6.96
	50	6.5	9.03
	60	6.5	11.7
	70	6.5	15.5
	80	6.5	21.4
	90	6.5	33.5
Intermodal <sup>b</sup>	95	3.2	48.4
	99	2.6	94.1

<sup>a</sup>Mass median aerodynamic diameter (MMAD) = 0.188  $\mu\text{m}$ ; geometric standard deviation ( $\sigma_g$ ) = 1.54; density ( $\rho$ ) = 1.7 g/cm<sup>3</sup>.

<sup>b</sup>MMAD = 1.70  $\mu\text{m}$ ;  $\sigma_g$  = 1.90; density ( $\rho$ ) = 1.7 g/cm<sup>3</sup>.

<sup>c</sup>MMAD = 16.4  $\mu\text{m}$ ;  $\sigma_g$  = 2.79; density ( $\rho$ ) = 1.7 g/cm<sup>3</sup>.